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Plan for Developing and Implementing the LLNL Plutonium Facility and Packaging Program

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Introduction

The LLNL Plutonium Facility uses glove boxes for performing operations involving special nuclear materials (SNM) that for the most part are not connected to each other. Having stand-alone glove boxes mandates bag-in and bag-out operations to provide personnel safety in material transfers. The use of inexpensive disposable primary and secondary containers (i.e., food pack and paint cans) decreases operational risks by reducing glove box transfers. Typically, containers consist of produce cans, paint cans, lard cans, and egg cans; however, some cans with bolted flanges have been used for protection from oxidation or to reduce dose to the handler. The lard cans and egg cans are slip lid cans and have predominantly been used for the outermost containment, or secondary can, in the packaging configuration. For non-weapon parts the packaging has generally been, from the inner most container to the outside container as (1) the primary can, (2) a bag-out bag, (3) a poultry bag, and (4) a secondary can. This system has evolved over many years and has proven to be effective.

During FY2002 through FY2004, the "Legacy" material projects at LLNL inspected, repackaged and processed (if necessary), approximately 1500 items, which translates to at least 3000 containers (primary and secondary). There were no failed containers identified during this repacking campaign; however, a documented technical basis does not exist for LLNL's current packaging system. In addition, this system may not meet drop test criteria. To assure that material is packaged and stored safely and consistently, LLNL is developing criteria for packaging and storage of special nuclear materials, as well as the associated technical basis. This document describes the plan for developing these criteria, technical basis, and implementation of the approved packaging and storage plan.

Materials and Package/Storage Requirements

The first step in developing a packaging and storage program is identification of what materials need to be packaged and stored, and the associated requirements. The packaging and storage program will only be for materials in the programmatic inventory because all excess items are already placed in a queue for processing to meet the DOE-STD-3013 requirement for long-term storage. SNM associated with ANSI qualified measurement standards, sealed (fabricated) weapons parts, DOE STD-3013 storage cans, welded fuel assemblies, or items in approved shipping containers will not be included in the plan. In addition, SNM-bearing waste is not covered by this proposed plan and will continue to be handled in accordance with accepted LLNL waste management practices. The forms of the materials that will be packaged and corresponding requirements are summarized in Table 1. Materials that are not approved for storage are liquid solutions, gases, and explosive materials.

Table 1
Materials and Packaging Requirements for Special Nuclear Materials

Material: Metal and Calcined Oxide	
Package Attributes	**Requirement**
Sealed (Air-tight)	Prevent container rupture due to oxidation and volume expansion.
No plastic in direct contact with SNM	Prevent container rupture due to hydrogen gas pressurization.
Contamination containment	Prevent material release and worker exposure.
Withstand elevated drop	Prevent material release and worker exposure.
Radiation shielding (as required)	Decrease worker radiation exposure.
Plastic does not degrade by radiation or heat	Prevent container rupture due to plastic degradation gases.
Acceptable size	Needs to accommodate material.
Material: Non-Calcined Oxide, Contaminated Equipment, and Residues	
Package Attributes	**Requirement**
Vented	Prevent container rupture due to release of volatiles.
No plastic in direct contact with SNM	Prevent hydrogen gas generation.
Contamination containment	Prevent material release and worker exposure.
Withstand elevated drop	Prevent material release and worker exposure.
Radiation shielding (as required)	Decrease worker radiation exposure.
Plastic does not degrade by radiation or heat	Prevent hydrogen gas generation.
Acceptable size	Needs to accommodate material.
Material: Salt and Salt-Containing Residues	
Package Attributes	**Requirement**
Sealed (Moisture-tight)	Prevent container rupture due to corrosion.
Contamination containment	Prevent material release and worker exposure.
Withstand elevated drop	Prevent material release and worker exposure.
Radiation shielding (as required)	Decrease worker radiation exposure.
Plastic does not degrade by radiation or heat	Prevent container rupture due to plastic degradation gases.
Acceptable size	Needs to accommodate material.
Material: Weapon Components	
Package Attributes	**Requirement**
No plastic in direct contact with SNM	Prevent container rupture due to hydrogen gas pressurization.
Contamination containment	Prevent material release and worker exposure.
Withstand elevated drop	Prevent material release and worker exposure.
Radiation shielding (as required)	Decrease worker radiation exposure.
Plastic does not degrade by radiation or heat	Prevent container rupture due to plastic degradation gases.
Acceptable size	Needs to accommodate material and any volume expansion from oxidation.

Development of Technical Basis for Packaging and Storage

The second step in developing a packaging and storage program is establishing the technical basis and functional criteria for each of the requirements identified in Table 1. The issues to be addressed for the packaging system includes material payload, corrosion effects, contamination containment, radiation level, radiolysis effects, thermal effects, pressure effects, and drop and impact resistance. Material criteria include evaluations of flammable gas buildup, pyrophoricity, decay heat, production of explosive gases, and the presence or generation of moisture.

In order to address worker exposure and safety issues the payload (SNM) will be evaluated for wattage (heat), radiation, and corrosiveness. In addition the containers will be evaluated for robustness in a number of areas: heat resistance, radiation shielding, and strength of materials (pressure and corrosion resistance as well as breach resistance). Pressure data will be required to qualify a container's adequacy. Details on resistance to corrosion will be evaluated or payloads will be limited to inhibit corrosion processes. Drop test criteria will be established for LLNL Plutonium Facility storage requirements.

An inspection/surveillance process and schedule will also be established as part of these storage criteria.

Development of the Packaging

The third step in developing a packaging and storage program is development of a packaging system that meets the functional criteria and operational constraints. In developing the packaging and storage criteria, a literature search will be conducted to identify useful information on cans used within the DOE complex and SNM-bearing material behavior in storage. Documents used as guidelines for developing the packaging are: (1) Charles B. Curtis, "Criteria for Interim Storage of Plutonium Bearing Materials," DOE Memorandum, Jan. 1996, and (2) Dan Guzy, "Degradation and Failure of Stored Radiological Material Containers and Packages," DOE Report, HQ-EH-2004-01, Jan. 2004. The LANL Comprehensive Storage and Packaging Plan will also be considered when that document is finalized and released. An example of the expected LLNL packaging assembly for all SNM, except for weapon components, from the inside outward would be (1) primary can, (2) bag-out bag, (3) poultry bag, (4) secondary can, and (5) drop-tested over-pack can. The innermost can would contain the SNM. The material to be stored would be placed directly into the innermost can so that there would be no contact with plastic. The lid of the innermost can would be closed with an airtight seal. The innermost can would be placed in a bag-out bag that would be taped shut. The bag-out bag would be placed in a poultry bag, that would also be taped shut. This package would be placed in a secondary can and the lid closed. In some cases, the lid of the secondary can would be vented with a filter if there was a concern for potential gas pressure generation. The secondary can would be packaged in a drop-tested over-pack can (usually vented). As a good ALARA practice, a radiation shield would be used on over-pack containers where material with a high radiation field would be packaged. All packaging configurations will be determined by their ability to satisfy the LLNL developed requirements and technical bases.

Review and Approval

The fourth step in creating a packaging and storage program is the safety, authorization basis, and operational review and approval of the packaging system. This will require that a Facility Engineering Design Review (FEDR) be conducted. The FEDR involves all safety disciplines, facility engineering, facility safety, criticality safety, quality assurance and facility management. In addition to the safety review, a review and approval by the Plutonium Facility staff including the Authorization Basis (AB) group will be completed. The criteria and packaging system will be evaluated against all authorization basis documentation (DSA, TSR, FSP, OSP, etc.). The FEDR process is detailed in the *Plutonium Facility—Building 332 Work Control/Design Change Control Process Manual,* UCRL-AR-133170.

Implementation

The implementation (i.e., the repackaging of items) of this plan will begin immediately following the final approval of the documented packaging system assuming sufficient resources are made available.

Schedule

The plan for producing the *LLNL Plutonium Facility and Packaging Program* as described in this document of producing a completed report by July 2006. Due to a recent OA-40 audit, many of the Plutonium Facility staff and all of the AB staff are unavailable to discuss and review this work. June 2005 is estimated to be the earliest date the AB staff would be available to support this project. Therefore, the completion date is dependent on the Authorization Basis (AB) staff being available to provide necessary support for all issues related to changes in the authorization basis related documentation and its implementation. The date is also predicated on the fact that chosen containers pass the required structural testing (i.e., drop, corrosion, pressure, leak, heat, etc.) within the six months allocated for testing. The implementation of this plan will begin immediately following the final approval of the document assuming required funding is made available. Currently there is no funding available for this project and the entire schedule is based on availability of the adequate resources to complete the listed tasks. Delay in funding will translate into a delay in schedule. The schedule is given in Fig. 1. The estimated cost to implement this schedule is $1M excluding the procurement of any newly identified containers and the implementation of repacking to meet the new criteria.

Figure 1. Packaging Schedule

Packaging Schedule